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Drainage Summary Report, Project Narrative & Engineering Report
Property of Dean & Deborah Hatfield – 6 Nutmeg Lane, Darien, CT

The owners propose constructing a pool, patio, and walkway in the rear yard at 6 Nutmeg Lane. The site presently consists of a house, driveway, patios, and lawn. The proposed improvements to the 1.003-acre site will lead to an increase in impervious area of approximately 1,700 SF. This report will show that the runoff from the pool and patio can be detained in a subsurface infiltration area and the project will not have an adverse impact on downslope properties or drainage facilities.

Runoff from the site flows generally from west to east across the property towards a lawn wetland. Once the water flows over the lawn wetland it discharges to a wooded wetland and watercourse system on an adjacent, downstream parcel. Runoff from the existing house and driveway flows untreated and unabated towards the wetland and watercourse system. The existing site has been identified as “Site” in the enclosed existing and proposed conditions hydrologic analysis. Using the SCS TR-20 Method, we have computed the existing and proposed runoff rates and volumes for the 1-, 2-, 5-, 10-, 25-, and 50-Year, 24-Hour Storms generated by the proposed activities. A summary of the runoff rates and volumes from the site is included in Table I.

Table I – Summary of Runoff Rates & Volumes from Site

Storm Event	Flow/Volume	Existing	Proposed	Δ	Δ(%)
1-Year	q (cfs)	1.21	1.19	-0.02	-1.65%
	v (CF)	4,495.00	4,449.00	-46.00	-1.02%
2-Year	q (cfs)	1.70	1.66	-0.04	-2.35%
	v (CF)	6,208.00	6,148.00	-60.00	-0.97%
5-Year	q (cfs)	2.37	2.32	-0.05	-2.11%
	v (CF)	8,635.00	8,550.00	-85.00	-0.98%
10-Year	q (cfs)	3.06	3.00	-0.06	-1.96%
	v (CF)	11,172.00	11,058.00	-114.00	-1.02%
25-Year	q (cfs)	4.20	4.18	-0.02	-0.48%
	v (CF)	15,449.00	15,286.00	-163.00	-1.06%
50-Year	q (cfs)	5.27	5.22	-0.05	-0.95%
	v (CF)	19,506.00	19,302.00	-204.00	-1.05%

In order to achieve the reduction in runoff rates and volumes outlined above, runoff from the pool and patio will be detained in a gravel bed/planter just below the pool. As the planter fills with water it will slowly drain through a weep hole at the base of the planter. This planter and gravel bed will also detain the Water Quality Volume (WQV) for the new impervious surfaces. Runoff from the remainder of the site will be allowed to discharge along existing drainage paths. The proposed activities will be constructed in Flood Zone “X” as delineated on the attached site plan. Please refer to the enclosed calculations and plans for further details.

With these proposed drainage structures in place, it is our professional opinion that there will be no adverse hydrological or hydraulic impacts caused to surrounding or downstream properties or drainage facilities by this development. To the best of my knowledge, this drainage proposal complies with the Town of Darien Planning and Zoning Regulations.



Respectfully submitted,

Frangione Engineering, LLC

A handwritten signature in blue ink, appearing to read "R. Frangione", written over the printed name.

Robert M. Frangione, P.E.
Owner & Chief Engineer
March 3, 2021

Enclosures



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Water Quality Volume Calculations
Hatfield – 6 Nutmeg Lane, Darien, CT
March 3, 2021

Equivalent Runoff Volume Requirement Calculations:

Pr. Pool:	635 SF
Pr. Patio & Pad:	1,101 SF
Total “New” Area:	1,736 SF

Water Quality Volume (WQV) Calculations:

Total Contributing Area = 0.04 ac. = 1,736 SF (Patio, pool and equipment pad)

Impervious Area = 1,736 SF = 0.04 ac.

Woods Area = 0 SF = 0.0 ac.

Lawn Area = 0 SF = 0.0 ac.

$$\%I = (0.04/0.04) = 1.0$$

$$RvI = 0.95$$

$$\%T = (0.0/0.04) = 0.0$$

$$RvT = 0.22$$

$$\%F = (0.00/0.04) = 0.0$$

$$RvF = 0.04$$

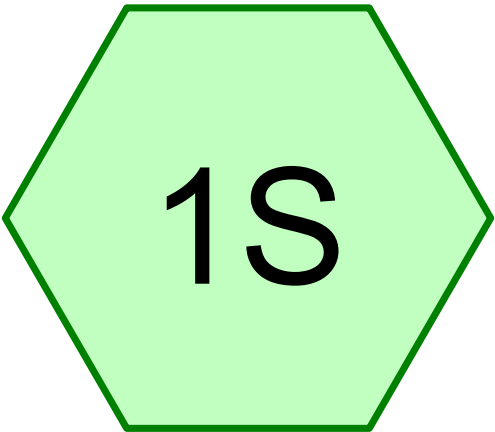
$$\begin{aligned} R &= (RvI \times \%I) + (RvT \times \%T) + (RvF \times \%F) \\ &= (0.95)(1.0) + (0.22)(0.0) + (0.04)(0.0) = 0.95 \end{aligned}$$

$$WQV = (1'' \times R \times A)/12$$

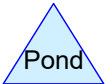
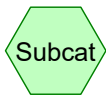
$$= (1'' \times 0.95 \times 0.04 \text{ ac.})/12 = 0.0032 \text{ ac.-ft.} = 137.9 \text{ CF}$$

Proposed Detention Facility: Gravel bed behind lower wall

$V_{\text{stone}} = 165 \text{ CF}$ (per hydrologic analysis) >> WQV required => WQV storage is met.



Site



Events for Subcatchment 1S: Site

Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)
1-Year	2.90	1.21	4,495
2-Year	3.50	1.70	6,208
5-Year	4.30	2.37	8,635
10-Year	5.10	3.06	11,172
25-Year	6.40	4.20	15,449
50-Year	7.60	5.27	19,506
100-Year	9.10	6.60	24,672

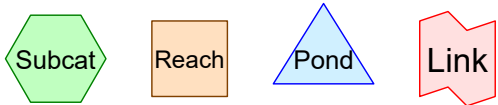
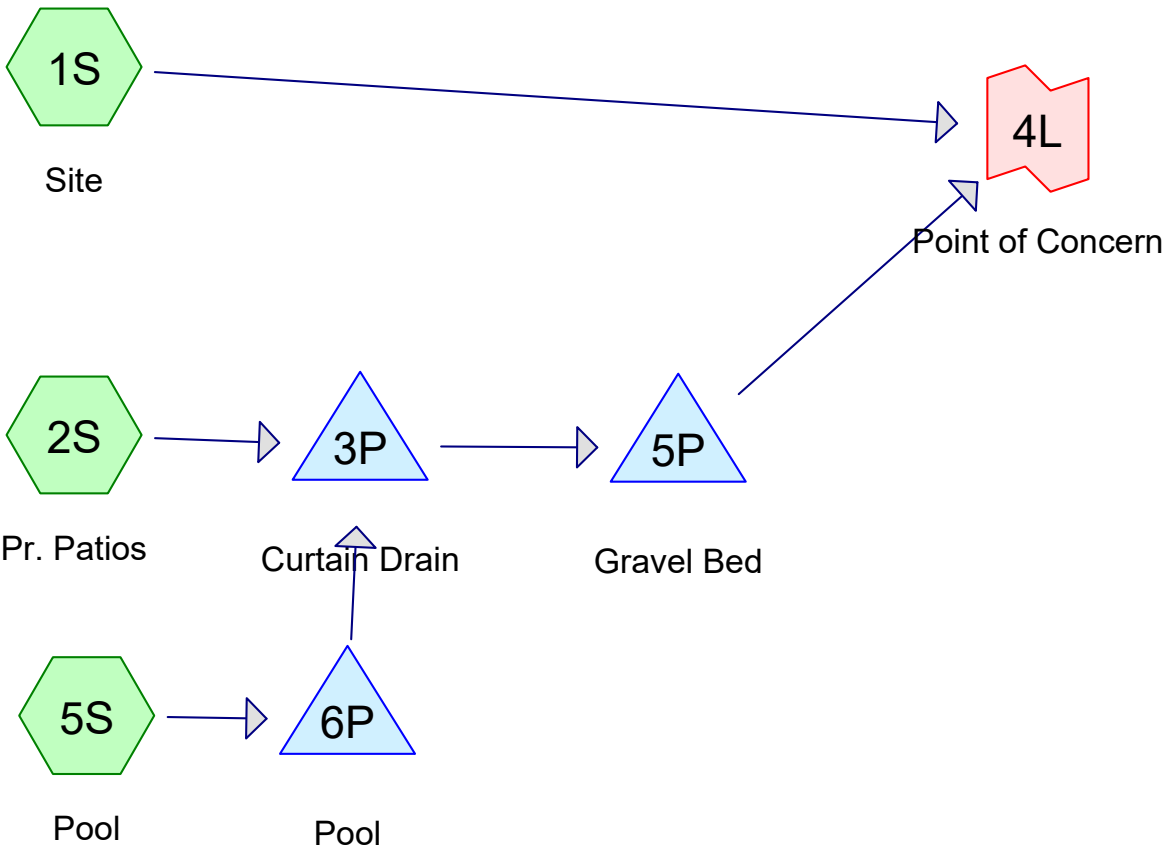
Summary for Subcatchment 1S: Site

Runoff = 5.27 cfs @ 12.15 hrs, Volume= 19,506 cf, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Type III 24-hr 50-Year Rainfall=7.60"

	Area (sf)	CN	Description
*	3,805	98	Ex.House
*	2,864	98	Ex. Drive
*	815	98	Ex. Patio
*	7	98	Ex. Walks
*	19	98	Ex. Pads
*	12,539	83	Woods, Poor, HSG D (wetlands)
	23,651	74	>75% Grass cover, Good, HSG C
	43,700	81	Weighted Average
	36,190		82.81% Pervious Area
	7,510		17.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	100	0.0400	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 3.50"
0.6	130	0.0485	3.55		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
10.9	230	Total			



Hatfield Proposed

Prepared by Microsoft

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Type III 24-hr 100-Year Rainfall=9.10"

Printed 3/3/2021

Events for Link 4L: Point of Concern

Event	Rainfall (inches)	Inflow (cfs)	Volume (cubic-feet)
1-Year	2.90	1.19	4,449
2-Year	3.50	1.66	6,148
5-Year	4.30	2.32	8,550
10-Year	5.10	3.00	11,058
25-Year	6.40	4.18	15,286
50-Year	7.60	5.22	19,302
100-Year	9.10	6.54	24,489

Summary for Subcatchment 1S: Site

Runoff = 5.00 cfs @ 12.15 hrs, Volume= 18,499 cf, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Type III 24-hr 50-Year Rainfall=7.60"

	Area (sf)	CN	Description
*	3,805	98	Ex.House
*	2,864	98	Ex. Drive
*	815	98	Ex. Patio
*	7	98	Ex. Walks
*	79	98	Ex. & Pr. Pads
*	12,539	83	Woods, Poor, HSG D (wetlands)
	21,334	74	>75% Grass cover, Good, HSG C
	41,443	81	Weighted Average
	33,873		81.73% Pervious Area
	7,570		18.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	100	0.0400	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 3.50"
0.6	130	0.0485	3.55		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
10.9	230	Total			

Summary for Subcatchment 2S: Pr. Patios

Runoff = 0.26 cfs @ 12.09 hrs, Volume= 850 cf, Depth> 6.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Type III 24-hr 50-Year Rainfall=7.60"

	Area (sf)	CN	Description
*	1,041	98	Pr. Patio
	581	74	>75% Grass cover, Good, HSG C
	1,622	89	Weighted Average
	581		35.82% Pervious Area
	1,041		64.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry,

Summary for Subcatchment 5S: Pool

Runoff = 0.11 cfs @ 12.08 hrs, Volume= 389 cf, Depth> 7.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Type III 24-hr 50-Year Rainfall=7.60"

	Area (sf)	CN	Description
*	635	98	Pr. Pool
	635		100.00% Impervious Area

Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
6.0					Direct Entry,

Summary for Pond 3P: Curtain Drain

Inflow Area = 2,257 sf, 74.26% Impervious, Inflow Depth > 4.63" for 50-Year event
Inflow = 0.26 cfs @ 12.09 hrs, Volume= 871 cf
Outflow = 0.24 cfs @ 12.12 hrs, Volume= 864 cf, Atten= 7%, Lag= 1.8 min
Primary = 0.24 cfs @ 12.12 hrs, Volume= 864 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs / 2
Peak Elev= 100.49' @ 12.12 hrs Surf.Area= 130 sf Storage= 31 cf

Plug-Flow detention time= 10.7 min calculated for 863 cf (99% of inflow)
Center-of-Mass det. time= 5.8 min (798.1 - 792.3)

Volume	Invert	Avail.Storage	Storage Description	
#1	99.90'	157 cf	Custom Stage Data (Prismatic)Listed below (Recalc)	

Elevation	Surf.Area	Voids	Inc.Store	Cum.Store
(feet)	(sq-ft)	(%)	(cubic-feet)	(cubic-feet)
99.90	130	0.0	0	0
99.91	130	40.0	1	1
102.89	130	40.0	155	155
102.90	130	100.0	1	157

Device	Routing	Invert	Outlet Devices	
#1	Primary	100.00'	4.0" Vert. Orifice/Grate	C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.24 cfs @ 12.12 hrs HW=100.49' (Free Discharge)
1=Orifice/Grate (Orifice Controls 0.24 cfs @ 2.74 fps)

Summary for Pond 5P: Gravel Bed

Inflow Area = 2,257 sf, 74.26% Impervious, Inflow Depth > 4.59" for 50-Year event
Inflow = 0.24 cfs @ 12.12 hrs, Volume= 864 cf
Outflow = 0.23 cfs @ 12.14 hrs, Volume= 803 cf, Atten= 6%, Lag= 1.4 min
Primary = 0.23 cfs @ 12.14 hrs, Volume= 803 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs / 2
Peak Elev= 99.93' @ 12.14 hrs Surf.Area= 244 sf Storage= 134 cf

Plug-Flow detention time= 67.0 min calculated for 803 cf (93% of inflow)
Center-of-Mass det. time= 28.0 min (826.1 - 798.1)

Volume	Invert	Avail.Storage	Storage Description	
#1	97.99'	135 cf	Custom Stage Data (Prismatic) Listed below (Recalc)	
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
97.99	244	0.0	0	0
98.00	244	40.0	1	1
99.00	244	40.0	98	99
99.01	244	15.0	0	99
99.93	244	15.0	34	133
99.94	244	100.0	2	135

Device	Routing	Invert	Outlet Devices	
#1	Primary	98.50'	2.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads	
#2	Primary	99.93'	67.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)	

Primary OutFlow Max=0.19 cfs @ 12.14 hrs HW=99.93' (Free Discharge)
↑**1=Orifice/Grate** (Orifice Controls 0.12 cfs @ 5.60 fps)
└**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.07 cfs @ 0.22 fps)

Summary for Pond 6P: Pool

Inflow Area =	635 sf,100.00% Impervious, Inflow Depth > 7.36"	for 50-Year event
Inflow =	0.11 cfs @ 12.08 hrs, Volume=	389 cf
Outflow =	0.00 cfs @ 19.51 hrs, Volume=	21 cf, Atten= 99%, Lag= 445.3 min
Primary =	0.00 cfs @ 19.51 hrs, Volume=	21 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs / 2
Peak Elev= 103.14' @ 19.51 hrs Surf.Area= 635 sf Storage= 368 cf

Plug-Flow detention time= 1,036.0 min calculated for 21 cf (5% of inflow)
Center-of-Mass det. time= 550.0 min (1,291.4 - 741.4)

Volume	Invert	Avail.Storage	Storage Description	
#1	102.56'	375 cf	Custom Stage Data (Prismatic) Listed below (Recalc)	
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
102.56	635	0	0	
103.15	635	375	375	

Device	Routing	Invert	Outlet Devices	
#1	Primary	103.14'	40.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)	

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Type III 24-hr 50-Year Rainfall=7.60"

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Primary OutFlow Max=0.00 cfs @ 19.51 hrs HW=103.14' (Free Discharge)

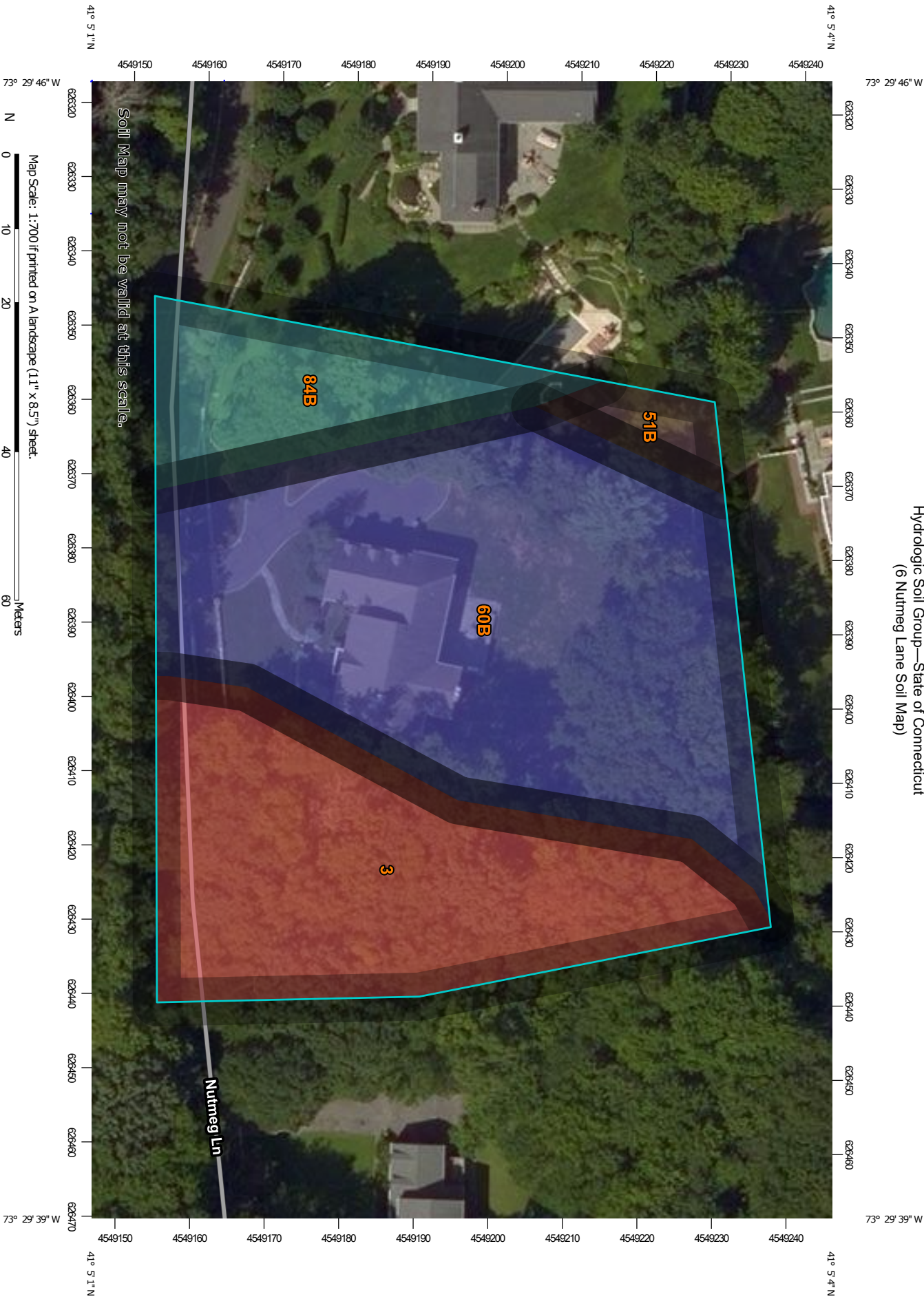
↑1=**Sharp-Crested Rectangular Weir** (Weir Controls 0.00 cfs @ 0.04 fps)

Summary for Link 4L: Point of Concern



























Inflow Area = 43,700 sf, 21.16% Impervious, Inflow Depth > 5.30" for 50-Year event
Inflow = 5.22 cfs @ 12.15 hrs, Volume= 19,302 cf
Primary = 5.22 cfs @ 12.15 hrs, Volume= 19,302 cf, Atten= 0%, Lag= 0.0 min








Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs

Hydrologic Soil Group—State of Connecticut
(6 Nutmeg Lane Soil Map)



MAP LEGEND

Area of Interest (AOI)			C
	Area of Interest (AOI)		C/D
Soils			D
Soil Rating Polygons			Not rated or not available
	A		
	A/D		
	B		
	B/D		
	C		
	C/D		
	D		
	Not rated or not available		
Soil Rating Lines			Local Roads
	A		
	A/D		
	B		
	B/D		
	C		
	C/D		
	D		
	Not rated or not available		
Soil Rating Points			A
	A/D		
	B		
	B/D		

Water Features			Streams and Canals
Transportation			Rails
			Interstate Highways
			US Routes
			Major Roads
			Local Roads
Background			Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: State of Connecticut
Survey Area Data: Version 20, Jun 9, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 21, 2014—Aug 27, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
3	Ridgebury, Leicester, and Whitman soils, 0 to 8 percent slopes, extremely stony	D	0.5	33.0%
51B	Sutton fine sandy loam, 0 to 8 percent slopes, very stony	B/D	0.0	2.9%
60B	Canton and Charlton fine sandy loams, 3 to 8 percent slopes	B	0.9	51.8%
84B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes	C	0.2	12.3%
Totals for Area of Interest			1.7	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher